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11. Mathematical Physics

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A New Way of Reconstructing the Density of the Earth From Measurements of the Gravitational Potential

The gravimetry problem of physical geodesy is concerned with the inversion of Newton's gravitational potential

$$V(y) = \int\limits_{\overline{B_{int}}} \frac{F(x)}{|x-y|}\, dx,$$

where $\overline{B_{int}} := \{x \in \mathbb{R}^3 \,|\, |x| \leq \beta\}$. Unfortunately the solution is not unique. More precisely there exists a decomposition $\mathcal{L}^2(\overline{B_{int}}) = H(\overline{B_{int}}) \oplus H(\overline{B_{int}})^{\perp}$, where $H(\overline{B_{int}})$ is the set of distributionally harmonic functions on $\overline{B_{int}}$. Functions in the orthogonal space are called anharmonic. It is already known that the corresponding integral operator is only injective on $H(\overline{B_{int}})$. Hence the presented way to solve the problem consists of two steps:

Step 1: The harmonic part is reconstructed from V using new wavelet methods.

Step 2: Based on a-priori informations the anharmonic part is determined in a subset of $H(\overline{B_{int}})^{\perp}$ using a special spline concept.